

TWO PREHISTORIC PUEBLOAN AVIFAUNAS FROM THE PECOS VALLEY, SOUTHEASTERN NEW MEXICO

STEVEN D. EMSLIE

Environmental Studies Department

University of California

Santa Cruz, CA 95064

JOHN D. SPETH

Museum of Anthropology

University of Michigan

Ann Arbor, MI 48109

REGGE N. WISEMAN

Office of Archaeological Studies

Museum of New Mexico

Santa Fe, NM 87504

ABSTRACT.—We present identification of avifaunal remains from two late prehistoric sites in the Pecos Valley, Chaves County, southeastern New Mexico. The Henderson site (LA-1549), a 50-70 room pueblo, and the Rocky Arroyo site (LA-25277), a small pitroom community of only three or four structures, were contemporaneous or nearly so, with principal occupation most likely beginning ca. A.D. 1250-1275 and ending A.D. 1325. At least 48 taxa (genera and species) are represented in these avifaunas, including the easternmost record known for Scarlet Macaw (*Ara macao*) in the prehistoric Southwest. All other taxa presently occur in southern New Mexico, but some only during migration and in winter, suggesting that exploitation of many aquatic species (e.g., geese and ducks) was occurring during the winter months. Comparison of these avifaunas indicates site-specific differences in the use of birds, with a greater emphasis on aquatic taxa at Rocky Arroyo. The avifaunas also support the hypothesis that prehistoric Pueblo Indians practiced site-specific hunting specializations for particular species or groups of birds. Trade (directly or indirectly) with Mesoamerica is indicated by the presence of the Scarlet Macaw and possibly also by the presence of the cardinal.

RESUMEN.—Presentamos la identificación de restos de avifauna de dos sitios prehistóricos tardíos en el Valle de Pecos, Condado de Chaves, al sureste de Nuevo México. El Sitio Henderson (LA-1549), un pueblo con 50 a 70 cuartos, y el Sitio Rocky Arroyo (LA-25277), una pequeña comunidad de cuartos-foso con solo tres o cuatro estructuras, fueron aproximadamente contemporáneos; su ocupación principal se dio muy probablemente entre circa 1250/1275-1325. Por los menos 48 taxa (géneros y especies) están representados en estas avifaunas, incluyendo el registro más oriental conocido de la guacamaya escarlata (*Ara macao*) en el Suroeste de los E.E.U.U. en el período prehistórico. Todos los demás taxa

se encuentran actualmente en el sur de Nuevo México, pero algunos de ellos están presentes solamente durante las migraciones y el invierno, lo cual sugiere que el aprovechamiento de varias especies acuáticas (gansos y patos) se hacía durante los meses invernales. La comparación entre estas avifaunas indica diferencias específicas a cada sitio en el uso de aves, con un mayor énfasis en los taxa acuáticos en Rocky Arroyo. Las avifaunas también apoyan la hipótesis de que los indígenas Pueblo prehispánicos practicaban especializaciones de caza, específicas a cada sitio, para especies o grupos de aves particulares. El comercio (directo o indirecto) con Mesoamérica es indicado por la presencia de la guacamaya escarlata, y posiblemente también por la presencia del cardenal.

RESUME.—Nous présentons l'identification de restes d'oiseaux venant de deux sites préhistoriques de la vallée du Pecos (comté de Chaves, au Sud-Est du Nouveau-Mexique). Le site d'Henderson (LA-1549), un pueblo de 50 à 70 pieces, et celui de Rocky Arroyo (LA-25277), une petite communauté de trois ou quatre structures semisouterraines, étaient à peu près contemporains, leur principale période d'occupation se situant très probablement entre 1250-75 et 1325 ap J.C. Au moins 48 genres et espèces sont représentés parmi ces oiseaux, y-compris l'occurrence la plus orientale connue dans le Sud-Ouest préhistorique pour le Ara écarlate (*Ara macao*). Tous les autres types se trouvent à présent au sud du Nouveau-Mexique, mais quelques-uns seulement pendant les migrations et en hiver, ce qui suggère que l'exploitation de nombreuses espèces aquatiques (oies et canards) avait lieu pendant les mois d'hiver. La comparaison de ces restes d'oiseaux indique des différences spécifiques à chaque site dans l'utilisation de ceux-ci, en particulier un usage plus intensif des types aquatiques à Rocky Arroyo, et permet de supporter l'hypothèse selon laquelle les Indiens Pueblos préhistoriques pratiquaient une chasse spécialisée de groupes et d'espèces d'oiseaux spécifiques à chaque site. Le commerce (direct ou indirect) avec le Mexique est attesté par la présence du Ara écarlate, et peut-être par celle du cardinal.

INTRODUCTION

The Henderson (LA-1549) and Rocky Arroyo (LA-25277) sites are two late prehistoric (ca. A.D. 1250-1400) puebloan villages located about 8 km apart in the Hondo River drainage, a major western tributary of the Pecos River, Chaves County, southeastern New Mexico (Fig. 1). The Henderson site, partly excavated by personnel from the Museum of Anthropology of the University of Michigan in 1980 and 1981, is situated on a low limestone ridge that flanks the south edge of the Hondo where this drainage first enters the alluvial flats of the Pecos Valley. The elevation of the Henderson site is about 1,186 m. The Rocky Arroyo site, at an elevation of about 1,133 m, is located in the alluvial flats of the Pecos Valley almost due east of Henderson, about 100 m east of the Rocky Arroyo drainage and approximately 1 km upstream (south) from the confluence of this small intermittent drainage with the old channel of the Hondo.¹ Rocky Arroyo was excavated almost in its entirety during the 1970s by amateurs belonging to the Chaves County Archaeological Society (CCAS). Small-scale salvage excavations in one of the structures at Rocky Arroyo were conducted there in 1980 by one of us (RNW).

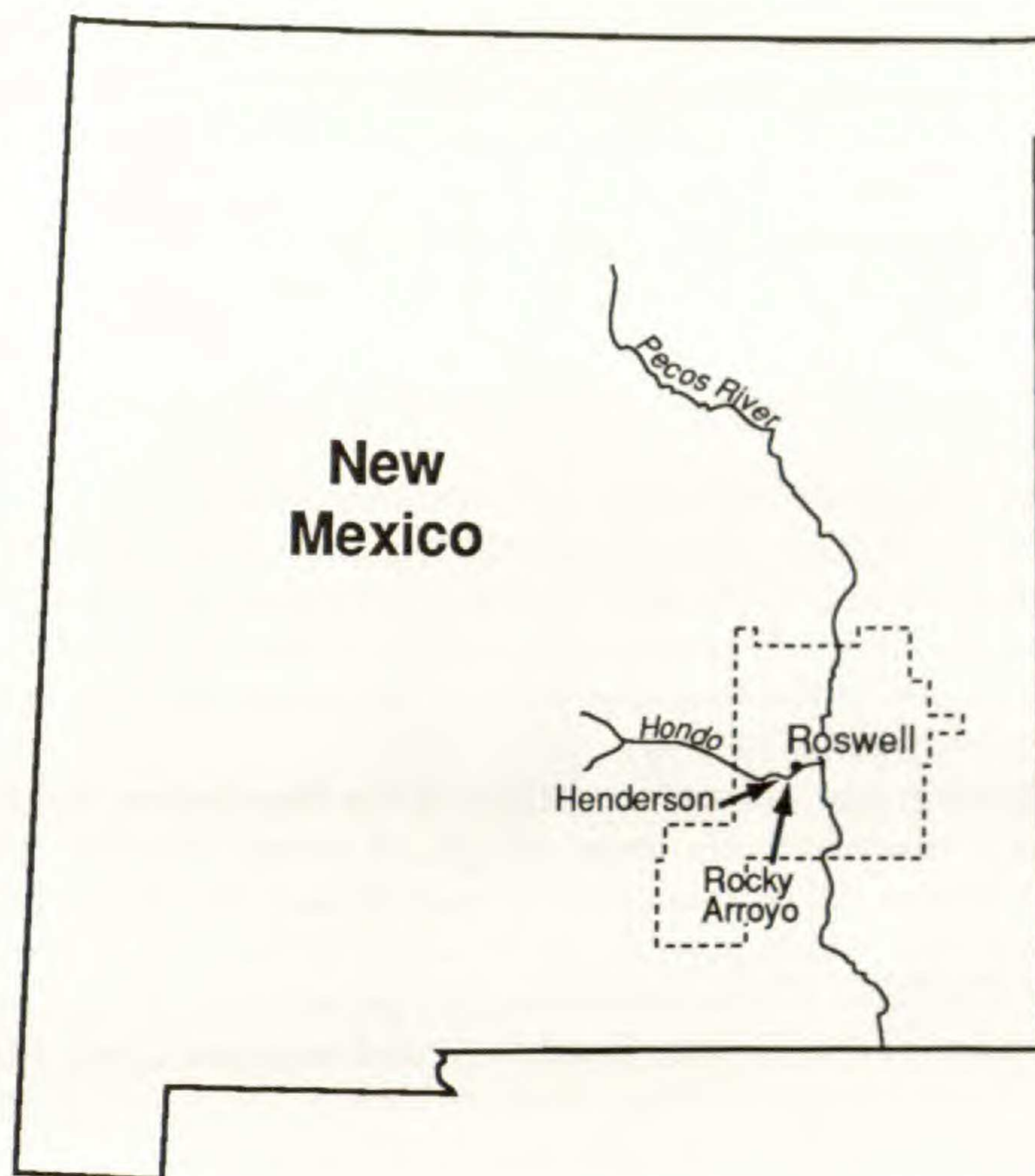


FIG. 1.—Location of the Henderson site (LA-1549) and Rocky Arroyo site (LA-25277), Chaves County (shown by dashed line), southeastern New Mexico.

The present-day vegetation in the area of the Henderson and Rocky Arroyo sites has been altered significantly over the past century by overgrazing, land-leveling, channelizing and damming the Hondo River, and lowering the local water table for irrigation farming and for meeting the domestic and commercial needs of the growing city of Roswell. These changes have reduced the local vegetation cover, and favored increases in more drought-resistant species. Today, the less disturbed open flats and limestone ridges in the area support a variety of grasses, especially the gramas (black, *Bouteloua eriopoda*; blue, *B. gracilis*; side-oats, *B. curtipendula*) and tobosa (*Hilaria mutica*), while dense growths of sacaton (*Sporobolus* sp.) occur along the margins of the normally dry channels of the Hondo and Rocky Arroyo drainages. Other plants common today in the area include broom snakeweed (*Gutierrezia sarothrae*), prickly pear and cholla cactus (*Opuntia* spp.), yucca (*Yucca* spp.), greasewood (*Sarcobatus* sp.), four-wing salt bush (*Atriplex canescens*), and mesquite (*Prosopis* spp.). Very few trees grow near the sites today; most were planted near ranch headquarters as ornamentals or for shade. Wild species are found primarily near the Henderson site, where they grow in a narrow band along the channel of the Hondo. Among the more common trees are cottonwood (*Populus* sp.), hackberry (*Celtis* sp.), wild walnut (*Juglans* sp.), and salt cedar (*Tamarix* sp.), the last introduced historically to control erosion.

The climate of the Roswell area today is semiarid. Roswell receives about 295 mm of rain annually (Houghton 1974:802). Winters are relatively dry, with the period from November through March receiving about 58 mm of precipitation. Therefore over 80% (i.e., 237 mm) of the average annual rainfall occurs during the seven months from April to October. Rains come in two distinct periods. The first is in May, followed by a slight decline in June. The principal rainy season, often characterized by intense thunderstorms, occurs from July through September; nearly 45% of the annual precipitation falls during these three months.

Summers in Roswell are warm, with average daily maxima exceeding 32°C (90°F) from June through August. Winters are mild, with average daily highs, even in January, of 12.8°C (55.1°F). Average minimum daily temperatures drop below freezing from mid-November through mid-March, but rarely drop to 0°F. The average length of the frost-free season, 206 days, extends from 7 April to 30 October (Von Eschen 1961:51).

The excavation and salvage operations at the Henderson and Rocky Arroyo sites yielded a comparatively large sample of avian remains: 548 specimens representing at least 120 individuals of at least 48 taxa. We present identifications of these avifaunas, which provide information on the use of birds by the late prehistoric inhabitants of this fascinating but poorly known region that borders the eastern edge of the Greater Southwest and western Great Plains.

SITE DESCRIPTION AND METHODS

The Henderson site.—The Henderson site is an E-shaped adobe pueblo of 50–70 large, rectangular, single-story rooms (Fig. 2). The room blocks are arranged with the longest or main bar of the “E” oriented roughly 60 degrees west of true north and the shorter bars (referred to henceforth as the east, center, and west bars) extending to the south (i.e., away from the Hondo). The open spaces enclosed between the shorter bars form small plaza areas, designated the east and west plazas. No evidence of a kiva has been found in either plaza, and none of the rooms tested to date shows evidence of specialized ceremonial functions.

Most of the excavations at Henderson have been confined to rooms in the east and center bars, and to the south end of the east plaza (Fig. 2, Fig. 3, and Fig. 4). With the notable exception of a series of subfloor burials, which yielded a diversity of grave accompaniments (see Rocek and Speth 1986), very few artifacts were found in situ on room floors or cached in pits or other features. Instead, most archaeological materials (e.g., lithics, sherds, animal bones, charcoal) were found randomly dispersed throughout room fill. Only two clearly in situ ashy midden deposits were encountered, one nearly filling room C-5 in the center bar, the other toward the south end of the east plaza. These two deposits produced most of the animal bones at Henderson, including many of the bird remains reported here.

The midden in the east plaza deserves further comment. This deposit appears to represent the remains of a huge roasting complex, located in or adjacent to

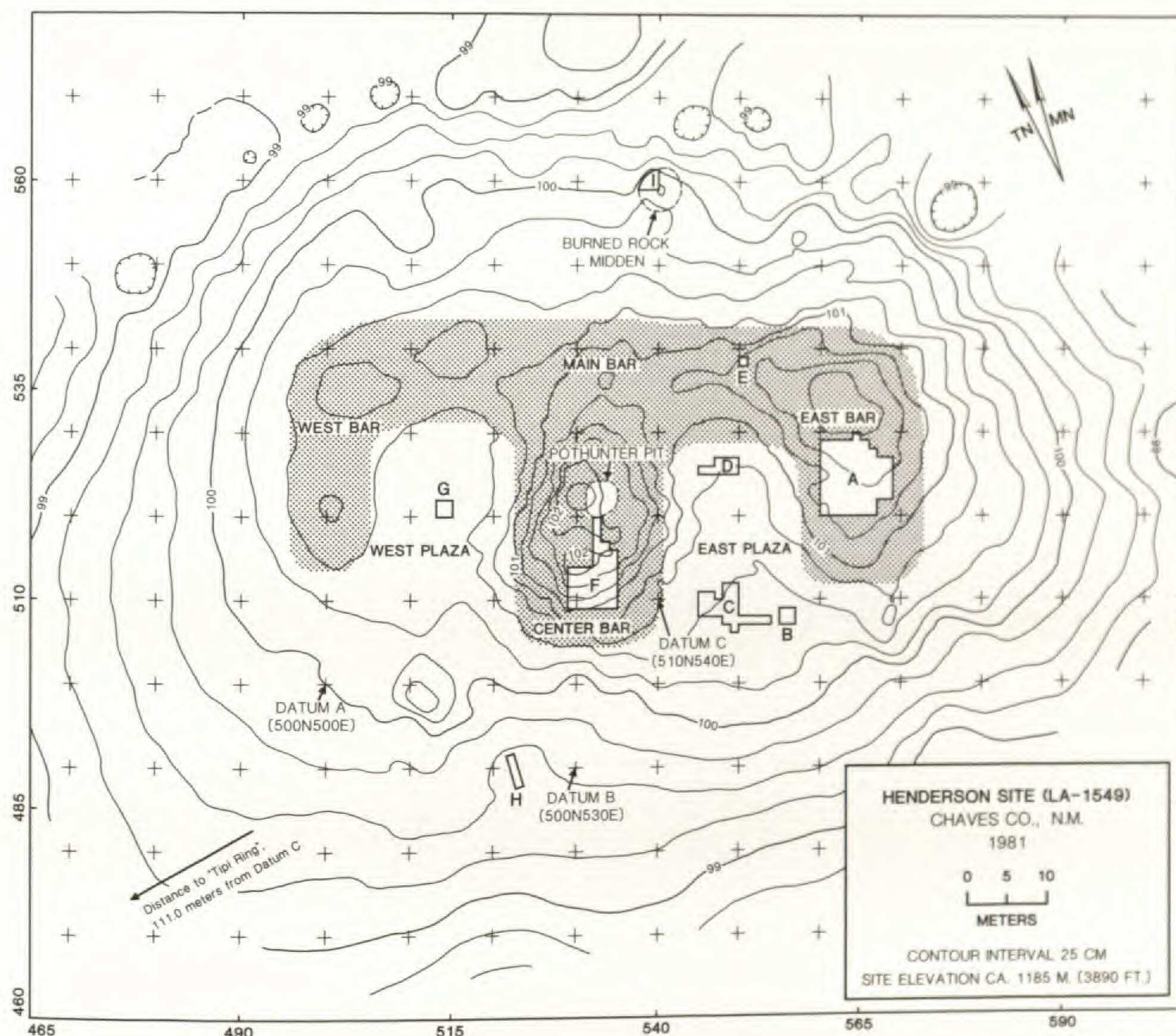


FIG. 2.—Map of Henderson site (LA-1549) showing location of principal excavation units.

a shallow, natural gully in the bedrock that directly underlies the plaza surface. While the precise location of the original roasting feature has not been identified, its proximity is indicated by the large quantities of burned and fractured limestone rock, expedient heavy-duty limestone choppers and cleavers, dense ash and charcoal, and animal bones (including over two thousand bison bones) dumped into the gully. Much of this trash represents remains of activities carried out in the plaza, particularly the butchering and roasting of bison, but domestic trash from adjacent room blocks also appears to have been dumped into the gully as evidenced by large quantities of broken pottery and lithics, and debris from the manufacture of freshwater mussel shell ornaments.

The Rocky Arroyo site.—In contrast to the Henderson site, Rocky Arroyo consists of at least three large, deep rectangular pitrooms, irregularly spaced adjacent to an open midden-filled area, with no evidence of above-ground structures at the site (Fig. 5). The trash deposits and associated pitroom structures at Rocky Arroyo were almost completely excavated by the CCAS in the 1970s. The exca-

vators appear to have been systematic in their search for artifacts, screening much of the fill through quarter-inch mesh. Their excavations focused on three structures, two of which they emptied completely; they also excavated most of the associated midden deposits.

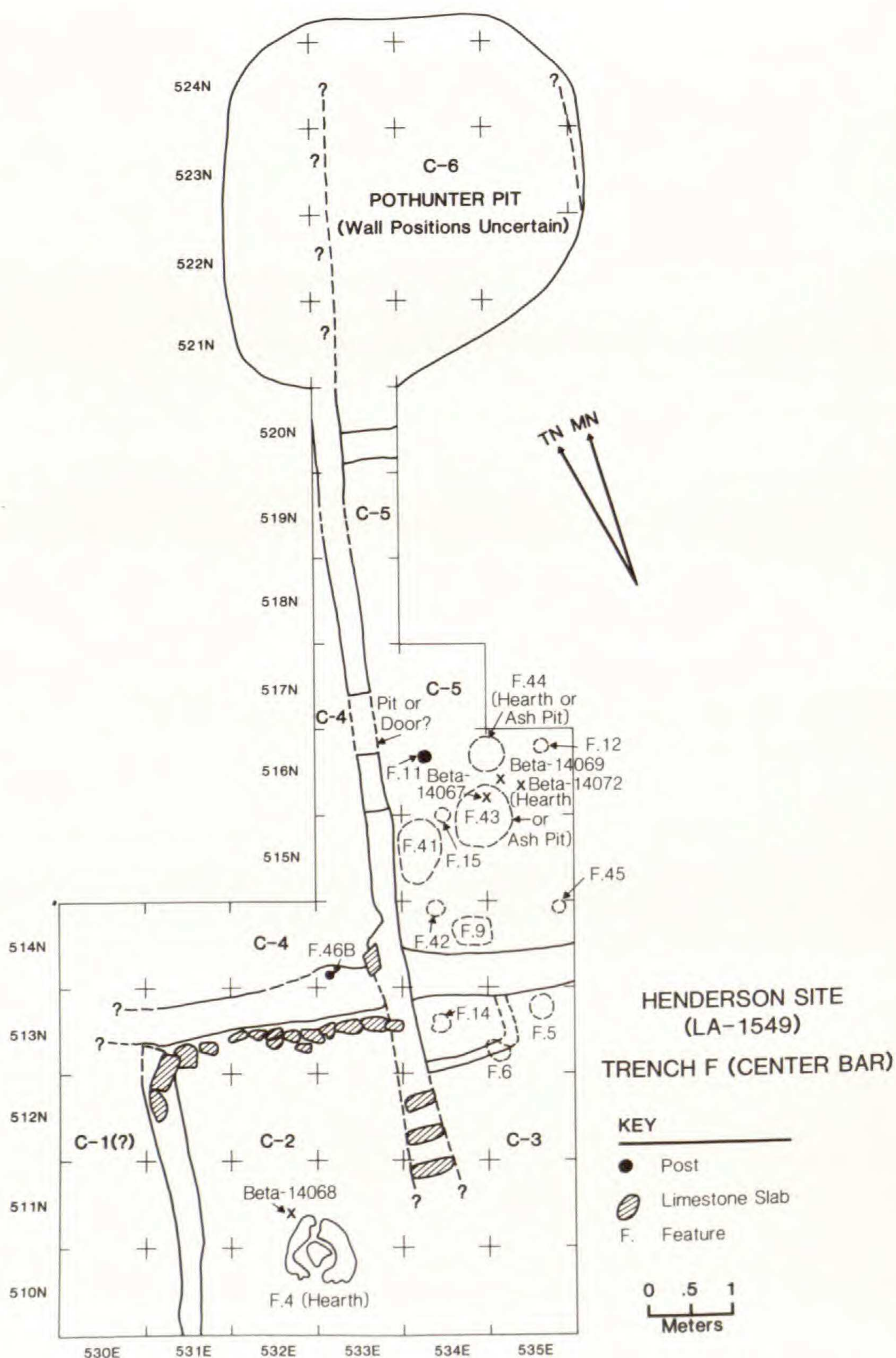


FIG. 3.—Plan of center bar at Henderson site (LA-1549) showing excavated rooms and features.

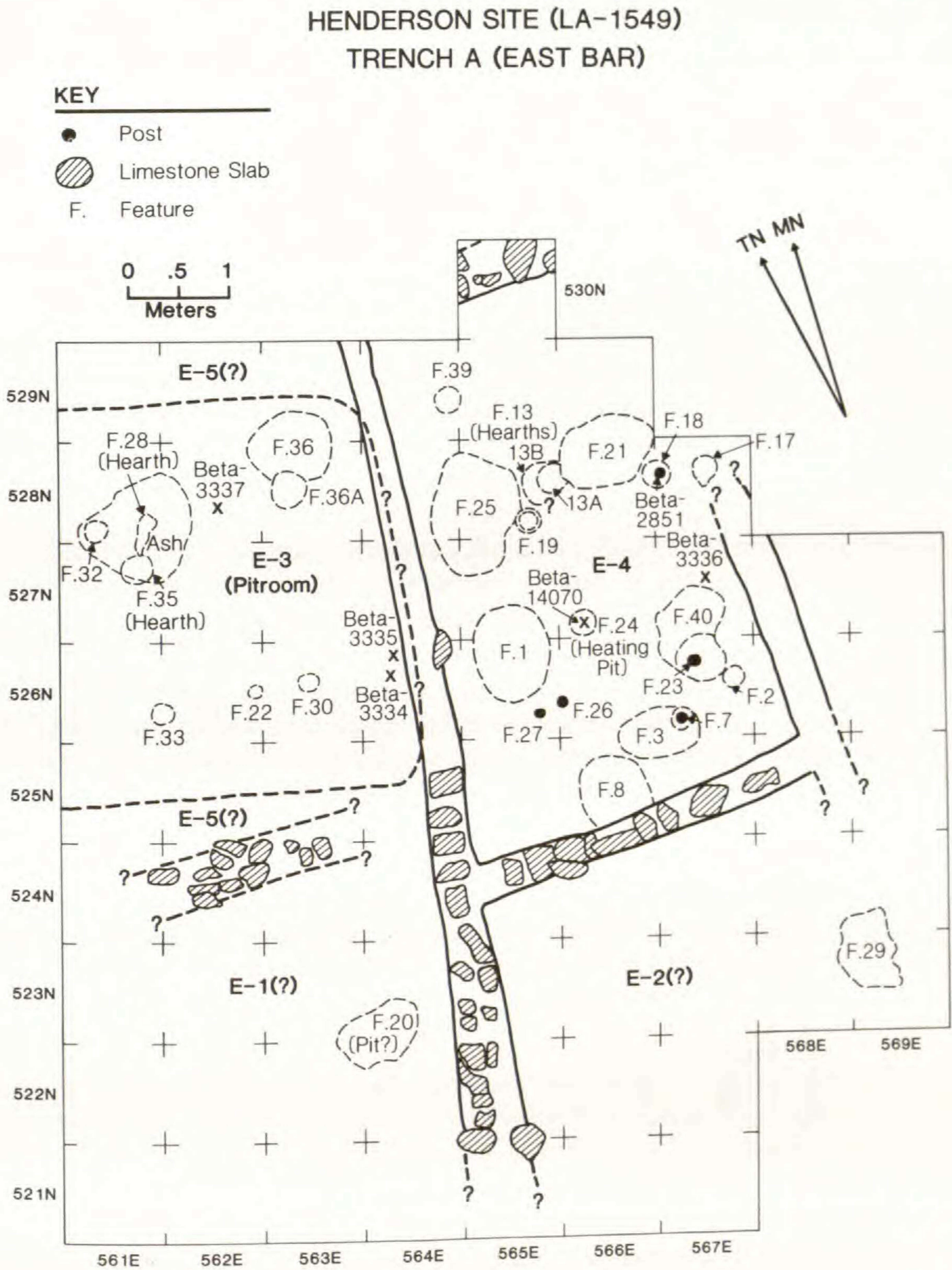


FIG. 4—Plan of east bar at Henderson site (LA-1549) showing excavated rooms and features.

The fate of the archaeological material recovered in these excavations is unknown, but faunal remains, as well as many human bones (mostly vertebrae and phalanges), lithics, sherds, and other debris were discarded and left in piles on the surface of the site. The excavators placed the bones into large metal tins, which they left near the structures where, presumably, the bones had been recovered; two of us (RNW and JDS) salvaged these materials and treated them with a polyvinyl-acetate preservative to prevent the bones from disintegrating.

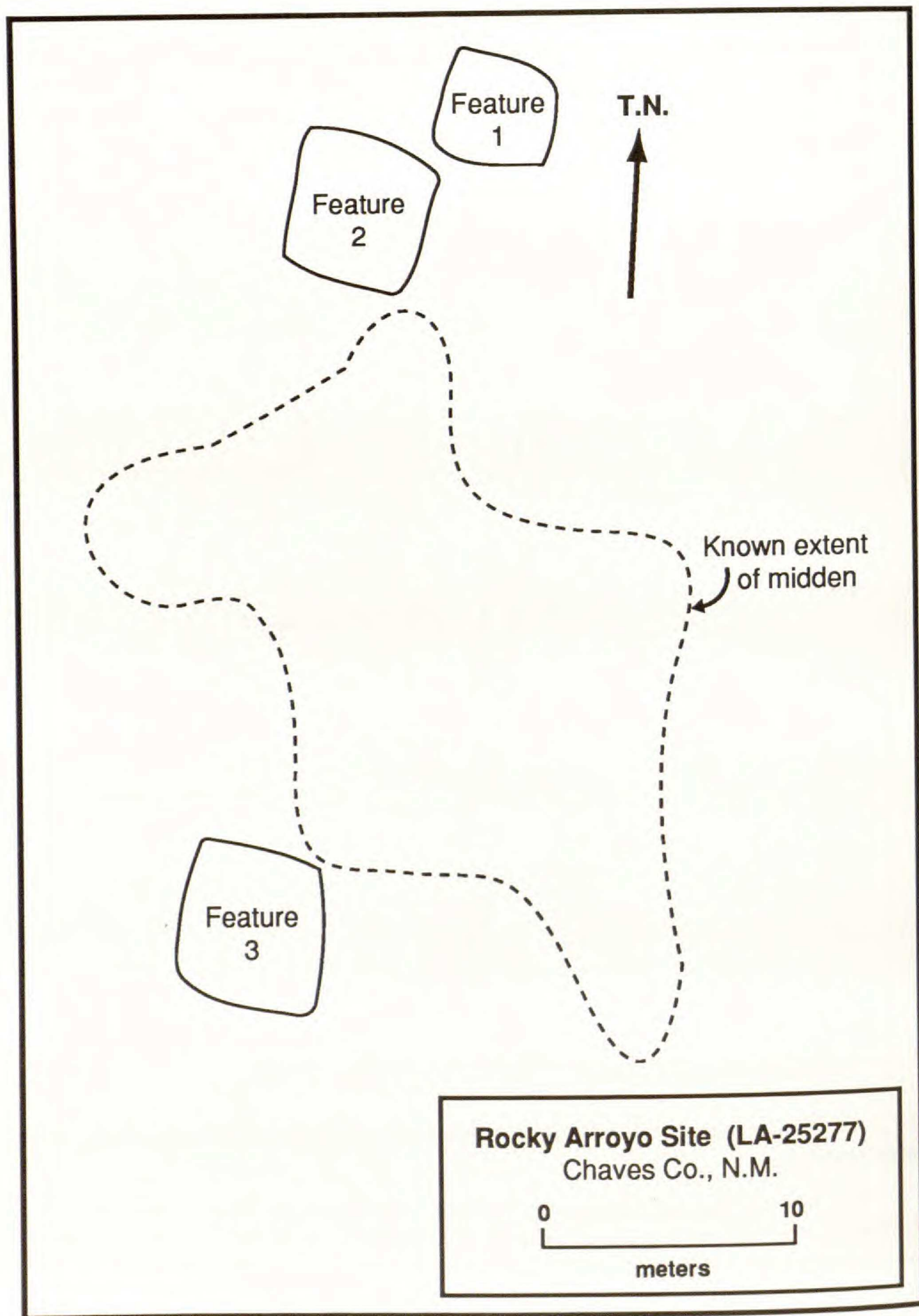


FIG. 5.—Sketch map of Rocky Arroyo site (LA-25277) showing approximate location of pitrooms and general midden deposits.

The biases in this faunal sample are difficult to assess. We are unable to determine with any certainty which bones came from structures and which came from extramural midden deposits, nor can we tell whether a tin contained bones from the structure nearest to it or from more distant ones as well. In addition, the comparatively small number of bones of small mammals and birds (e.g., rabbits, rodents, and passerines) suggests that either much of the deposits was not screened or that only larger bones were collected from the screens.

Fortunately, one of the three pithouses, Structure or Locus 2, was not totally emptied. A large wedge of undisturbed deposit was excavated by one of us (RNW) and all sediment processed by flotation and fine-screening using a 0.5 mm geological sieve. This sample contained thousands of well-preserved fish bones (including scales), as well as a wide array of other faunal remains, such as bison (*Bison* sp.), pronghorn (*Antilocapra americana*), muskrats (*Ondatra zibethicus*), and many rodent, rabbit, tortoise, and bird bones.

Age and correlation.—Ceramic evidence indicates that the Henderson and Rocky Arroyo sites date to the late prehistoric period. A series of radiocarbon and archaeomagnetic dates place the principal occupation at both sites between ca. A.D. 1250–1275 and A.D. 1325, with continuing but less intensive occupation or intermittent reoccupation of the Henderson site in the late 1300s or early 1400s (see Rocek and Speth 1986; Wiseman 1985).

While the ceramic assemblages from Henderson and Rocky Arroyo are virtually indistinguishable and suggest broadly equivalent ages for the two sites, the architectural differences between them—pithouses at Rocky Arroyo, above-ground adobe structures at Henderson—suggest that Rocky Arroyo may be slightly earlier than Henderson. However, in the absence of tree-ring dates or other criteria for precisely establishing the dates of the occupations, we cannot rule out the possibility that the architectural differences reflect ethnic, seasonal, or other factors rather than chronology.

The faunal remains.—Most faunal remains, including those of birds, from the Henderson site were collected from arbitrary 5 cm deep excavation units (1 m square grids), with all matrix sifted through quarter-inch mesh screens. Only a small number of avian specimens were recovered from flotation samples, although more than 300 large (>2 l) samples were processed from a wide variety of proveniences. A few Henderson avian specimens have complete provenience information written directly on them, denoting grid square and depth below a datum assigned an elevation of 100.00 m (e.g., 513N565E 101.20–101.15). Most bones from different units and archaeological features were assigned sequential “lot” numbers. These numbers are given for each identified bone listed in the Appendix table.²

All bones salvaged from the backdirt piles at Rocky Arroyo were assigned locus numbers based on the architectural or other feature nearest to where they were found (Fig. 5). Four such loci were identified, three of which (Loc. 1–3) are pitroom structures. Some bone found between Loc. 1 and 2 could not be assigned with confidence to either area and was labeled Loc. 1-2. Salvage exca-

ventions (by RNW) of the undisturbed deposits in Locus or Structure 2 greatly enlarged the total faunal sample, although most material recovered was bison and fish bones. These bones were assigned lot numbers to represent their stratigraphic provenience.

All bird bones were identified (by SDE) at the Museum of Vertebrate Zoology, University of California, Berkeley.³ Minimum numbers of individuals (MNI) for each taxon were determined by counting the most common element from one side and by morphologic comparisons of elements of different sides. The percentage of total number of identifiable specimens (NISP) per taxon was used to compare faunal samples by employing a test of equality and arcsine transformation to calculate a test statistic (t_s ; Sokal and Rohlf 1969). We used this test to determine significant differences ($p < 0.05$) in the percentage NISP by Order (intersite comparisons) and by skeletal element (intrasite comparisons) from Rocky Arroyo and Henderson. Comparisons of the proportions of wing versus leg elements by provenience were based on three paired elements for each category: radius, ulna, and carpometacarpus as wing elements because these bones support the majority of wing feathers, and femur, tibiotarsus, and tarsometatarsus as leg elements. We assumed no differential preservation of wing versus leg elements at these sites.

DISCUSSION

At least 48 taxa (genera and species) are represented by these avifaunas. Except for the macaw (*Ara macao*), all species are currently found in New Mexico, but many are migratory and occur in southern New Mexico primarily in the winter or spring and summer seasons (Table 1). The numerous aquatic taxa, especially from Rocky Arroyo, indicate the former presence of large rivers, marshes, and/or lakes. The Hondo River presently is dry most of the year as a result of damming and a lowering of the water table, but was a permanent stream in the late 1800s (Rocek and Speth 1986). Several species in the avifauna, including prairie falcon, scaled quail, and Chihuahuan raven, occur in open grasslands of the desert Southwest. Grasses and shrubs are the dominant vegetation of this semiarid region of New Mexico today (Rocek and Speth 1986).

The avifaunas reflect a much richer environment in the past than is present in this area of New Mexico today. This environment included a permanent source of water, the Hondo River, with associated wetlands and riparian habitats, and large, open grasslands. It is possible that some of the birds, particularly the aquatic species, were captured some distance away from the villages; if so, wetlands along the Pecos River, such as those still seen today in the Bitter Lake National Wildlife Refuge and the Bottomless Lakes State Park (both 25–30 km east of the villages), would have offered ideal habitats.

Intersite comparisons.—In addition to architectural differences between the Henderson and Rocky Arroyo sites, the avifaunas also differ (Table 1). Some of these differences are due to excavation and recovery biases against smaller bones (and hence against smaller species) at Rocky Arroyo. This bias is apparent in comparing the proportion (based on NISP values) of passerines in the Henderson

TABLE 1.—Avifauna from the Henderson (LA-1549) and Rocky Arroyo (LA-25277) sites, Chaves County, New Mexico, with total number of bones (NISP) and minimum number of individuals (MNI, in parentheses) for each taxon.

Taxon	LA-1549	LA-25277
Pied-billed Grebe (<i>Podilymbus podiceps</i>)	5 (1)	1 (1)
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)	—	7 (2)
Turkey Vulture (<i>Cathartes aura</i>)**1	1 (1)	2 (1)
Trumpeter Swan (<i>Cygnus buccinator</i>)*	—	2 (1)
Snow Goose (cf. <i>Chen caerulescens</i>)*	—	1 (1)
Canada Goose (<i>Branta canadensis</i>)*	—	5 (2)
Goose (Anserini, indet.)	—	2 (2)
Mallard (<i>Anas platyrhynchos</i>)*	1 (1)	12 (2)
Duck (<i>Anas</i> sp.)	1 (1)	1 (1)
Teal (<i>Anas</i> sp.)	6 (2)	7 (2)
Canvasback (<i>Aythya</i> cf. <i>A. valisineria</i>)*	3 (1)	—
Duck (<i>Aythya</i> sp.)	—	2 (1)
Scoter (<i>Melanitta</i> sp.)	—	1 (1)
Common Goldeneye (<i>Bucephala clangula</i>)*	—	3 (1)
Common Merganser (<i>Mergus merganser</i>)*	2 (1)	—
Merganser (cf. <i>Mergus</i> sp.)	—	2 (1)
Ruddy Duck (<i>Oxyura jamaicensis</i>)*	—	1 (1)
Anatidae, indet.	11 (3)	2 (1)
Bald Eagle (<i>Haliaeetus leucocephalus</i>)*	—	2 (1)
Northern Harrier (<i>Circus cyaneus</i>)*	—	1 (1)
Cooper's Hawk (<i>Accipiter cooperii</i>)	—	2 (1)
Goshawk (<i>Accipiter gentilis</i>)*	—	1 (1)
Swainson's Hawk (cf. <i>Buteo swainsoni</i>)**	2 (1)	2 (1)
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	1 (1)	1 (1)
Hawk (<i>Buteo</i> sp.)	14 (2)	11 (2)
Golden Eagle (<i>Aquila chrysaetos</i>)	3 (2)	1 (1)
American Kestrel (<i>Falco sparverius</i>)	2 (1)	—
Merlin (<i>Falco columbarius</i>)	—	1 (1)
Peregrine Falcon (<i>Falco</i> cf. <i>F. peregrinus</i>)*	—	3 (1)
Prairie Falcon (<i>Falco</i> cf. <i>F. mexicanus</i>)	—	1 (1)
Turkey (<i>Meleagris gallopavo</i>)	2 (1)	9 (2)
Quail (Odontophorinae, indet.)	11 (3)	—
Scaled Quail (<i>Callipepla</i> cf. <i>C. squamata</i>)	2 (2)	—
Virginia Rail (cf. <i>Rallus limicola</i>)	—	1 (1)

TABLE 1. (continued)

Taxon	LA-1549	LA-25277
Common Moorhen (<i>Gallinula chloropus</i>)	2 (2)	—
American Coot (<i>Fulica americana</i>)	60 (9)	119 (13)
Sandhill Crane (<i>Grus canadensis</i>)*	3 (1)	—
American Bittern (<i>Botaurus lentiginosis</i>)	—	1 (1)
Great Egret (<i>Casmerodius albus</i>)	1 (1)	—
Dowitcher (<i>Limnodromus</i> sp.）**	1 (1)	—
Gull (<i>Larus</i> sp.)	—	1 (1)
Mourning Dove (<i>Zenaida macroura</i>)	9 (3)	—
Scarlet Macaw (<i>Ara macao</i>)	—	7 (1)
Macaw (<i>Ara</i> sp.)	—	1 (1)
Screech Owl (<i>Otus</i> sp.)	1 (1)	—
Great Horned Owl (<i>Bubo virginianus</i>)	5 (2)	2 (1)
Burrowing Owl (<i>Athene cunicularia</i>)	9 (3)	—
Short-eared Owl (<i>Asio flammeus</i>)*	1 (1)	—
Owl (<i>Asio</i> sp.)	1 (1)	—
Northern Flicker (<i>Colaptes auratus</i>)	4 (1)	—
Flycatcher (<i>Tyrannus</i> sp.)	1 (1)	—
Steller's Jay (cf. <i>Cyanocitta stelleri</i>)*	—	1 (1)
Chihuahuan Raven (<i>Corvus cryptoleucus</i>)	6 (1)	4 (2)
Crow or Raven (<i>Corvus</i> sp.)	—	2 (1)
Northern Cardinal (<i>Cardinalis cardinalis</i>)	1 (1)	—
Lark Sparrow (<i>Chondestes grammacus</i>)**	1 (1)	—
Sparrow (<i>Zonotrichia</i> sp.)	2 (2)	—
Emberizinae, indet.	1 (1)	—
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	2 (1)	—
Meadowlark (<i>Sturnella</i> sp.)	4 (2)	—
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)*	1 (1)	—
Icterinae, indet.	—	1 (1)
Passeriformes, indet.	133	6
Total	316 (61)	232 (59)

¹Species that are migratory and found in southern New Mexico during winter months only are indicated by an asterisk (*); spring/summer migrants are indicated by a double asterisk (**) (Hubbard 1978).

sample with their proportion in the sample from Rocky Arroyo (Fig. 6). Passerines are well represented at Henderson, comprising over 48% of the total NISP (152 of 316 bones). In contrast, they constitute barely 6% of the total in the CCAS

sample from Rocky Arroyo (14 of 232 bones), but fully 50.0% of the smaller but systematically recovered sample from Structure 2 (6 of 12 bones), a value nearly identical to the one from Henderson.

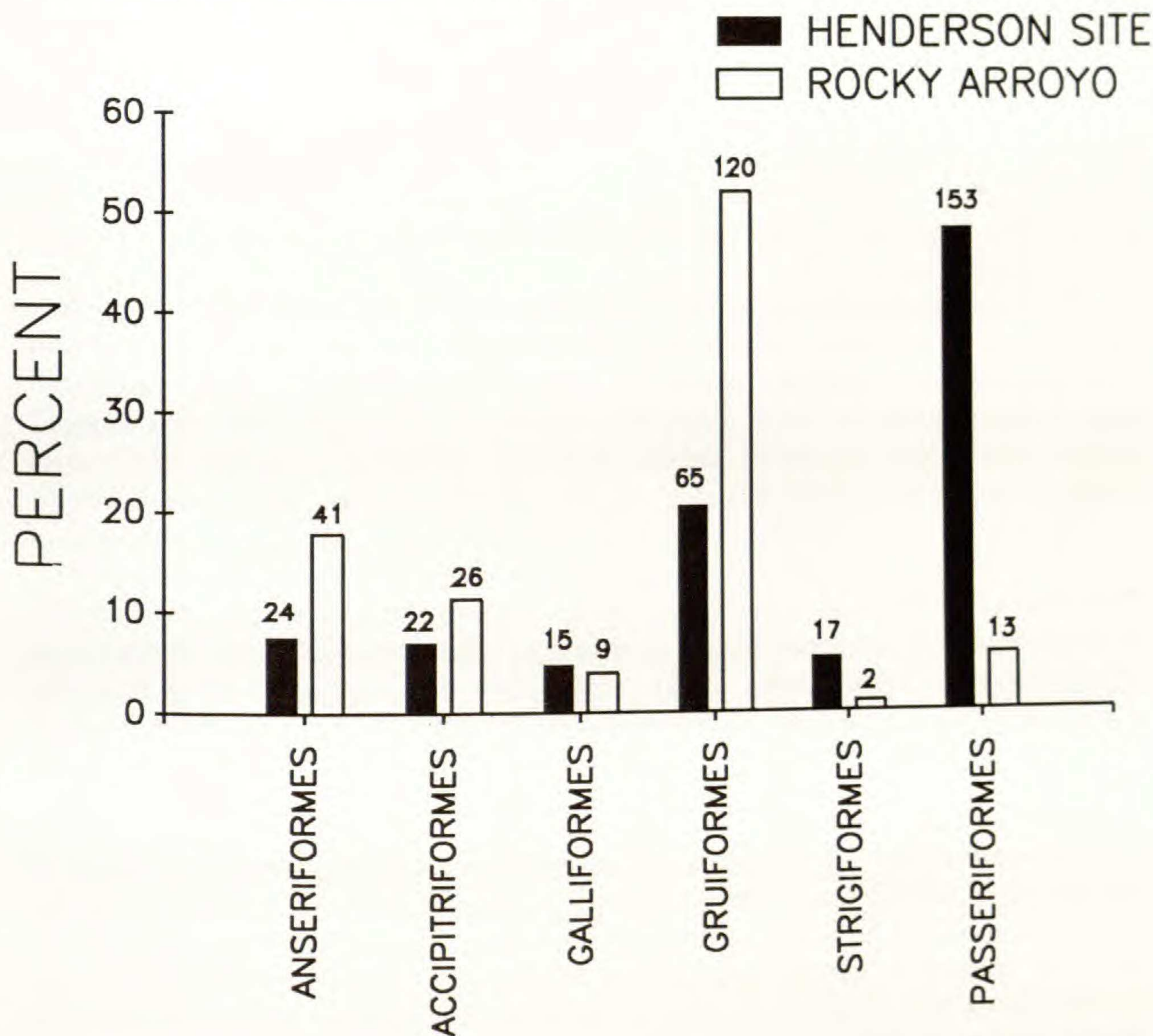


FIG. 6.—Percentage of total NISP (see Table 1) per order of bird bones identified from the Henderson site and Rocky Arroyo site. The number at the top of each bar is the NISP for that order.

It also is possible that some of the differences seen in Table 1 between the Henderson and Rocky Arroyo avifaunas are the result of post-depositional taphonomic processes, particularly differential bone preservation resulting in fewer bones of smaller species at Rocky Arroyo. However, preservation of small and fragile bones was generally excellent at both sites. For example, thousands of tiny, delicate fish bones were recovered at both sites, and many papery fish scales were found in the Structure 2 fill at Rocky Arroyo. Most of the damage on the Rocky Arroyo bones was in the CCAS sample. Not unexpectedly, excavation damage was most apparent on the larger bones, particularly those of bison, on which tool marks and fresh breaks were common. The smaller bones do not show this damage and display few recent breaks. Most bones,

regardless of size, were placed by the excavators in tightly packed tins which protected them from exposure to weathering and decay. While many of the larger bones had become brittle, cracked, and broken, there is little evidence to suggest that bones of any size had disintegrated into unrecognizable debris within the tins.

In sum, it seems reasonable to conclude that differences in the avifaunas between Henderson and Rocky Arroyo, with the exception of the bias against recovery of passerines from lack of screening at the latter site, may have a cultural origin. Thus, the most reliable intersite comparisons will be those that involve the larger-sized bird species, for which screening biases are likely to play a much smaller role.

Statistical comparisons of the percentage NISP per total NISP by orders represented at each site indicate that significantly more bones of Anseriformes and Gruiformes, especially American coot (*Fulica americana*), were recovered from Rocky Arroyo ($t_s > 3.6$, $p < 0.001$), and more of Strigiformes and Passeriformes (the latter, as noted above, probably reflecting recovery bias) from Henderson ($t_s > 4.9$, $p < 0.001$) (Fig. 6). In addition, bones of macaw and cormorant (one with cut-marks) occurred only at Rocky Arroyo, and bones of mourning dove (Columbiformes) were recovered only from the Henderson site. The absence of this last taxon from Rocky Arroyo, however, also may be due to recovery biases of small bones at this site. These comparisons suggest that aquatic birds, including rails, ducks, and geese, were exploited more at Rocky Arroyo than at Henderson. This conclusion is supported by the abundance of other aquatic taxa, including muskrat and a high diversity of fish, at Rocky Arroyo in comparison to Henderson (Wiseman 1985; Rocek and Speth 1986).

Intrasite comparisons.—The lack of secure provenience information for most of the avifaunal remains from Rocky Arroyo precludes intrasite comparison of the distribution of bird bones by species or body part. The sample from the Henderson site, however, can be analyzed in this manner with comparisons of bird remains from the room blocks with those from the midden associated with the roasting feature in the east plaza. Sample sizes are too small to permit comparisons among individual rooms.

These comparisons, best expressed in terms of the number of bird bones per cubic meter (m^3) of deposit, indicate relatively similar and low bone densities in most of the room blocks and in the east plaza (Table 2). In contrast to these modest values, the trash deposit in room C-5, the only significant midden deposit found in the rooms sampled to date, produced a density of bird bones ($11.63/m^3$) that is nearly 2.5 times greater than the east plaza value. The fill from room C-5 included more than half (53.4%) of the passerine remains recovered from the site, and their density in the trash ($8.10/m^3$; see Table 3) of this room was nearly 7.5 times greater than their density in the east plaza trash ($1.09/m^3$). Differences in densities of bones of other taxa in the rooms compared to the east plaza are based on too few NISP to be reliable.

Avifaunal exploitation.—Water birds are important in pueblo symbolism in relation to annual rainfall and the onset of the growing season (Tyler 1979). Conse-

TABLE 2.—Density (number of specimens per cubic meter of deposit) of avian bones by provenience at the Henderson site (all taxa combined).

Provenience	Total Volume Excavated (m ³)	Total Avian NISP	Total Avian Density (bones/m ³)
Center Bar			
All Rooms	25.76	166	6.44
Room C-5 only	8.77	102	11.63
Excluding Room C-5	16.99	64	3.77
East Bar	34.85	83	2.38
East Plaza (Trench C)	11.90	57	4.79

TABLE 3.—Number of bones (NISP) and density of bones per cubic meter of deposit (in parentheses) for principal taxa (order) by provenience at the Henderson site.

Order	Center Bar	Room C-5	East Bar	East Plaza
Gruiformes	34 (1.32)	1 (0.11)	29 (0.83)	11 (0.92)
Accipitriformes	11 (0.43)	5 (0.57)	3 (0.09)	6 (0.50)
Galliformes	11 (0.43)	7 (0.80)	0 (0.00)	2 (0.17)
Strigiformes	5 (0.19)	6 (0.68)	2 (0.06)	4 (0.34)
Passeriformes	108 (4.19)	71 (8.10)	40 (1.15)	13 (1.09)
Anseriformes	11 (0.43)	6 (0.68)	5 (0.14)	5 (0.42)

quently, duck and goose wing fans are used in ceremonies related to the agricultural cycle. Moreover, certain of these species are migratory and occur only in the winter in southern New Mexico (Table 1). These species were available primarily during late fall through early spring (Hubbard 1978). Bones of fledgling red-tailed hawk, quail, and raven suggest a late spring and summer exploitation of these species.

Many passerine species are also symbols of rain for Southwestern Native Americans; often stuffed birds are included in religious paraphernalia. In this respect, it is interesting that a significantly greater percentage of Passeriformes wing elements compared to leg elements were recovered from the Henderson site (Table 4), perhaps pointing to their particular importance as sources of feathers. Wing bones also outnumber leg bones at Rocky Arroyo, but the numbers are too small for reliable comparisons. Although most of the passerine bones from Henderson could not be identified, those that were include species commonly

TABLE 4.—Comparison of the distribution of wing (radius, ulna, carpometacarpus) and leg (femur, tibiotarsus, tarsometatarsus) elements by order at the Henderson site and Rocky Arroyo.

Order		Henderson site		Rocky Arroyo	
		NISP	%	NISP	%
Anseriformes:	wing	5	55.6	12	70.6
	leg	4	44.4	5	29.4
Accipitriformes:	wing	8	44.4	8	38.1
	leg	10	55.6	13	61.9
Galliformes:	wing	4	50.0	1	12.5
	leg	4	50.0	7	77.5
Gruiformes:	wing	13	34.2*	26	34.2*
	leg	25	65.8	50	65.8
Passeriformes:	wing	65	63.7*	6	66.7
	leg	37	36.3	3	33.3
Total Aquatic ¹	wing	21	39.6*	39	39.4*
	leg	32	60.4	60	60.6

¹The category for total aquatic taxa includes bones of Podicipediformes, Pelecaniformes, Ciconiiformes (except Turkey Vulture) and Charadriiformes in the NISP. An asterisk (*) indicates those proportions that are significantly different ($t_s > 2.1$, $p < 0.05$).

associated with agricultural fields, such as icterids, corvids, and sparrows (Emslie 1981a, 1981b, 1983).

While wing elements outnumber leg elements in passerines, this is not so in the other orders that are represented at the sites (Table 4). In the aquatic birds, especially Gruiformes, leg elements significantly outnumber wing elements. While this in no way precludes the use of aquatic bird feathers for ritual, fletching arrows, or other purposes, the abundance of leg elements suggests that these birds were used for food since the legs contain greater muscle mass than the wings. However, only five bird bones (less than 1%) from the two sites were burned, and most or all of these derive from species that were probably of little or no importance as sources of food: a humerus and an ulna of unidentified passerines from Henderson, and two *Corvus* sp. tibiotarsi and a tarsometatarsus of *Falco columbarius* from Rocky Arroyo. Moreover, none of the bones of aquatic species were burned.

If birds were being eaten in any quantity at Henderson and Rocky Arroyo, the scarcity of burned elements suggests that roasting was not a common method of preparation. This contrasts to bison: about 6% of the bison bones are burned. Interestingly, turkey (*Meleagris gallopavo*), probably an important source for food as well as feathers in the late prehistoric Southwest, is rare at both sites; only two bones were recovered from Henderson and nine from Rocky Arroyo. The apparent scarcity or absence of captive or domestic turkeys at the Henderson site,

a comparatively large village, is intriguing. A few unidentifiable shell fragments from eggs large enough to be turkey were recovered at Henderson. If these fragments do derive from turkey eggs, they might provide indirect evidence for the presence of captive or domestic birds in the village. However, they could easily have been taken from wild birds.

The large number of passerines at Henderson, as well as coots and other aquatic birds at both sites, suggests specialization in the use of avian resources by the occupants of these sites. Avifaunal specialization by Pueblo Indians is not unknown in the prehistoric Southwest. Over 2,000 bones of turkey (*Meleagris gallopavo*) from Sapawe Pueblo (A.D. 1400–1550) and Pottery Mound (A.D. 1325–1490; 88.4% and 64.0% of total avian NISP from these sites, respectively), and hundreds of bones of golden eagle from Picuris Pueblo (A.D. 1250–present; 34.4% of NISP) and sandhill crane from Pottery Mound (10.0% of NISP), indicate large-scale exploitation of these taxa specific to those pueblos (Emslie 1981a). At Rocky Arroyo and Henderson, the large number of coot bones is unusual. This species was poorly represented (<1% of total avian NISP) in the large samples of bone from Pottery Mound, Picuris, and Sapawe (Emslie 1981a). We speculate that coot may have had an important symbolic function at Rocky Arroyo and Henderson, similar to that of other aquatic species.

Site-specific avifaunal specialization in the Southwest may have been encouraged by the development of trade centers for distributing feather blankets, food, and whole birds or feathers for ceremonial use in puebloan religion. The symbolic role of birds is apparent from preserved kiva murals at Kuaua and Pottery Mound (Dutton 1963; Hibben 1975), and through ethnographic studies (Tyler 1979). Specialization also may have developed in relation with particular clans and/or kinship groups that occupied specific pueblos (Emslie 1981a). Based on the avifaunal data from Henderson and Rocky Arroyo, it is possible that these communities were gathering coots and passerines for local or regional exchange.

Prehistoric trade of birds.—The scarlet macaw bones at Rocky Arroyo indicate trade with Mesoamerica. At least one individual is represented by eight bones; included are elements of the skull, wings, and legs. The remains may have been part a single macaw burial, or one or more individuals from diverse proveniences. In addition to the macaw at Rocky Arroyo, seven copper bells (another trade item from Mesoamerica) were recovered from Bloom Mound, a roughly contemporaneous pueblo located within 2 km of Henderson (Kelley 1984).

Macaw bones and feathers are known from prehistoric sites throughout the Southwest as far north as southeastern Utah (Hargrave 1979). The bones from Rocky Arroyo represent the easternmost occurrence of this species in the prehistoric Southwest. In addition, if the age of this site is correct (1250/1275–1325), these bones represent one of the latest records of macaw trade prior to Spanish contact. Trade with Mesoamerica appears to have ceased in the 1300s (Kelley and Kelley 1975). This breakdown is supported by negative evidence at Pottery Mound, a pueblo established about A.D. 1325, or approximately when Rocky Arroyo was abandoned (though the age of this site may be more correctly placed at post-A.D. 1400, E. Charles Adams, personal communication to Speth, 1991).

This large pueblo produced thousands of bird bones, but none of macaw despite its frequent representation in the many kiva murals preserved there (Hibben 1975). A revival of macaw trade may have occurred in the 1400s (Hargrave 1970). Apparently, Rocky Arroyo represents one of the latest pueblo sites in the Southwest to be involved with trade from Mesoamerica before the breakdown.

Another possible trade item with Mesoamerica is the northern cardinal. This species was rare in Arizona and apparently absent in New Mexico prior to the 1870s, but expanded its range northward and eastward in the following decades (Phillips 1968). It did not become established in New Mexico until the early part of this century. We know of no other archaeological records of cardinal in New Mexico, though there are three records from Arizona with the earliest dating from A.D. 850-950 (Ferg and Rea 1983). These authors suggest that cardinals, because of their bright plumage similar to macaws, may have been brought into the American Southwest from Mesoamerica through trade. This suggestion assumes that the species only recently expanded its range northward, and did not formerly occur in the Southwest where it may have disappeared for unknown reasons prior to historic times. Until this problem is resolved, it is possible that the specimen from Rocky Arroyo represents an additional trade item at this site.

CONCLUSIONS

Excavations of the Rocky Arroyo and Henderson sites have provided diverse avifaunas that are the first of their age to be reported in detail from southeastern New Mexico. The presence of the scarlet macaw (*Ara macao*) at Rocky Arroyo is the easternmost record of this species in the prehistoric Southwest and, in conjunction with the copper bells from nearby Bloom Mound, and possibly also the cardinal from Henderson, indicates thirteenth and/or fourteenth century trade links between the Pecos Valley and regions to the west and south. Moreover, we believe these sites present additional evidence that specialized exploitation of avian resources, perhaps for trade, was occurring in the late prehistoric Southwest. This specialization probably developed in conjunction with an agricultural economy; many species of birds are highly symbolic among modern Pueblo Indians, especially in relation to the growing season.

The preponderance of aquatic species at Rocky Arroyo may reflect specialization at this site for birds that were used for food and religious/ceremonial purposes. A similar specialization in aquatic species was not apparent at the Henderson site, though it is located on the same drainage and is roughly contemporaneous with Rocky Arroyo. Henderson occupants may have specialized on the acquisition of passerines instead of waterfowl, but excavation biases may have caused an unbalanced recovery of these small birds from these sites.

NOTES

¹It should be pointed out that the name Rocky Arroyo also has been used for a late Pleistocene cave fauna and archaeological site from which fossil bird bones were reported by Wetmore (1931, 1932). However, this cave is located in Eddy County, northwest of Carlsbad, New Mexico, and is not the same Rocky Arroyo as discussed here.

²Proveniences associated with lot numbers 1-2027 have been published in Rocek and Speth (1986:300-342); proveniences for higher lot numbers, most of which denote specimens from flotation samples, have not been published but are available from JDS.

³All Rocky Arroyo specimens are deposited at the Laboratory of Anthropology of the Museum of New Mexico in Santa Fe; the Henderson materials are currently on long-term loan from the former land-owners of the site to the Museum of Anthropology of the University of Michigan in Ann Arbor. The final repository for these specimens has not yet been determined. The Henderson site has since been donated to The Archaeological Conservancy.

ACKNOWLEDGEMENTS

We acknowledge the generosity of Matthew and Karen Henderson, who made the University of Michigan excavations at the Henderson site possible. Jay Hollifield granted permission to the Museum of New Mexico to salvage the remaining fill from Structure 2 at Rocky Arroyo. Financial support for the analysis of the avifaunal remains was provided by the Museum of Anthropology of the University of Michigan. Mapping of Rocky Arroyo was done by William F. Turney. Graphics were done by Kay Clahassey. We also thank Amadeo Rea for helpful comments and suggestions in preparing this manuscript.

LITERATURE CITED

- DUTTON, BERTHA P. 1963. *Sun Father's Way*. University of New Mexico Press, Albuquerque.
- EMSLIE, STEVEN D. 1981a. Birds and prehistoric agriculture: The New Mexican pueblos. *Human Ecology* 9:305-329.
- . 1981b. Prehistoric agricultural ecosystems: Avifauna from Pottery Mound, New Mexico. *American Antiquity* 46:853-861.
- . 1983. Cultural and climatic implications in Anasazi faunal exploitation: A review and perspectives. Pp. 119-123 in *Proceedings of the Anasazi Symposium 1981*. Jack E. Smith (editor). Mesa Verde National Park and Museum Association, Colorado.
- FERG, ALAN and AMADEO M. REA. 1983. Prehistoric bird bone from the Big Ditch Site, Arizona. *Journal of Ethnobiology* 3:99-108.
- HARGRAVE, LYNDON L. 1970. *Mexican Macaws*. University of Arizona, Anthropological Paper No. 20.
- . 1979. A macaw feather artifact from southeastern Utah. *Southwestern Lore* 45(4):1-6.
- HIBBEN, FRANK C. 1975. *Kiva Art of the Anasazi at Pottery Mound*. KC Publications, Las Vegas.
- HOUGHTON, FRANK E. 1974. The climate of New Mexico. Pp. 794-810 in *Climates of the States, Vol. 2: Western States*. United States National Oceanic and Atmospheric Administration, Water Information Center, Port Washington, New York.
- HUBBARD, JOHN P. 1978. Revised check list of the birds of New Mexico. New Mexico Ornithological Society, Publication No. 6.
- KELLEY, J. CHARLES and ELLEN ABBOTT KELLEY. 1975. An alternative hypothesis for the explanation of Anasazi culture history. Pp. 178-223 in *Collected Papers in Honor of Florence Hawley Ellis*. Theodore R. Frisbie (editor). Papers of the Archaeological Society of New Mexico No. 2.
- KELLEY, JANE H. 1984. *The archaeology of the Sierra Blanca Region of southeastern New Mexico*. University of Michigan, Museum of Anthropology, Anthropological Paper No. 74.
- McKUSICK, CHARMION R. 1986. *Southwest Indian Turkeys*. Southwest Bird Laboratory, Globe, Arizona.
- OLSEN, SANDRA L. 1979. A study of bone artifacts from Grasshopper Pueblo, AZ P:14:1. *The Kiva* 44:341-373.

LITERATURE CITED (continued)

- PHILLIPS, ALLAN R. 1968. The instability of the distribution of land birds in the Southwest. *Papers of the Archaeological Society of New Mexico* 1:129-162.
- ROCEK, THOMAS R. and JOHN D. SPETH. 1986. The Henderson site burials: Glimpses of a late prehistoric population in the Pecos Valley. University of Michigan, Museum of Anthropology, Technical Report No. 18.
- SOKAL, ROBERT R. and F. JAMES ROHLF. 1969. *Biometry*. W.H. Freeman, San Francisco.
- TYLER, HAMILTON A. 1979. *Pueblo Birds and Myths*. University of Oklahoma Press, Norman.
- VON ESCHEN, G.F. 1961. The climate of New Mexico. University of New Mexico, Bureau of Business Research, Business Information Series 37.
- WETMORE, ALEXANDER. 1931. The California condor in New Mexico. *Condor* 33:76-77.
- . 1932. Additional records of birds from cavern deposits in New Mexico. *Condor* 34:141-142.
- WISEMAN, REGGE N. 1985. Bison, fish and sedentary occupations: Startling data from Rocky Arroyo (LA 25277), Chaves County, New Mexico. Pp. 30-32 in *Views of the Jornada Mogollon*. Colleen M. Beck (editor). Eastern New Mexico University, Contributions in Anthropology 12.

APPENDIX: REFERRED MATERIAL

Taxon	Element ¹	Description
Podicipediformes		
Podicipedidae		
<i>Podilymbus podiceps</i> (Linnaeus, 1758)	LA-1549: DL humerus, 1262; L ulna, Fea. 25; R carpometacarpus, 1123; DR femur, 1586; PL tibiotarsus, 2055 LA-25277: R ulna, Loc. 2	
Pelecaniformes		
Phalacrocoracidae		
<i>Phalacrocorax auritus</i> (Lesson, 1831)	LA-25277: PR humerus, Loc. 1; DR humerus, R femur, PR and PL tarsometatarsi, Loc. 1-2; PL humerus, Loc. 2; DL tarsometatarsus, Loc. 4	D humerus from Loc. 1-2 has small, oblique cut-marks on D external shaft.
Ciconiiformes		
Vulturidae		
<i>Cathartes aura</i> (Linnaeus, 1758)	LA-1549: DL ulna, 941 LA-25277: partial pelvis, Loc. 2; DR radius, Loc. 4	
Anseriformes		
Anatidae		
<i>Cygnus buccinator</i> Richardson, 1832	LA-25277: DL ulna, PR femur, Loc. 1-2	Specimens are distinguished from <i>C. columbianus</i> by their larger size and osteological characters. D ulna cut from shaft by groove and snap technique (Olsen 1979)
cf. <i>Chen caerulescens</i> (Linnaeus, 1758)	LA-25277: PR humerus, Loc. 2	
<i>Branta canadensis</i> (Linnaeus, 1758)	LA-25277: humeral end R coracoid, L scapula, Loc. 1-2; DL humerus, L carpometacarpus, wing phalanx, Loc. 2 Lot 1001.	Humerus measurements: D breadth and depth, 28.0, 16.8 mm. Carpometacarpus: length, 105.2 mm; P breadth and depth, 11.0, 28.3 mm; D breadth and depth, 11.6, 12.6 mm.

APPENDIX: REFERRED MATERIAL (continued)

Taxon	Element ¹	Description
Anserini, indet. <i>Anas platyrhynchos</i> Linnaeus, 1758	LA-25277: 2 manubria of sternum, Loc. 2 and 3.	Specimens fall within size range of <i>B. canadensis canadensis</i> , the most common subspecies in New Mexico. Element is too variable for generic recognition.
	LA-1549: L ulna missing P end, 1331.	
	LA-25277: 2 L scapulae, L coracoid, PL ulna, DR radius, DR humerus, Loc. 1-2, L coracoid, 2 PL humeri, R tarsometatarsus, Loc. 2; DL humerus, L carpometacarpus missing P end, Loc.3.	
<i>Anas</i> sp.	LA-1549: L coracoid, 540; R coracoid, 799; L ulna, 851; L radius, 1207; PL humerus, 791; 2 DL humeri, 1233 and 1452.	All bones, except L coracoid (540) and one R humerus from LA-25277, are from a teal-sized duck similar to <i>A. crecca</i> or <i>A. discors</i> . The two remaining bones are from a duck near the size of <i>A. acuta</i> or <i>A. clypeata</i> but are too fragmentary for specific identification.
	LA-25277: furculum, R radius, L ulna, L ulna missing D end, 2 R humeri missing P ends, Loc. 1-2; L humerus missing P end, DL carpo-metacarpus, Loc. 2.	
	LA-1549: L coracoid and humerus, 684; PL scapula, 1108. LA-25277: manubrium of sternum, DR ulna, Loc. 1-2.	
Aythya cf. <i>A. valisineria</i> (Wilson, 1814) <i>Aythya</i> sp.		

- Melanitta* sp.
Bucephala clangula
 (Linnaeus, 1758)
 LA-25277: PL carpometacarpus, Loc. 1-2
 LA-25277: DR humerus, R femur,
 Loc. 1-2; manubrium of sternum,
 Loc. 2.
Mergus merganser
 Linnaeus, 1758
 cf. *Mergus* sp.
 LA-1549: humeral end R coracoid, 794;
 PL humerus, 1384.
 LA-25277: DR carpometacarpus, Loc. 2;
 PR tibiotarsus, Loc. 1-2.
Oxyura jamaicensis
 (Gmelin, 1789)
 Anatidae, indet.
 LA-25277: R humerus missing P end,
 Loc. 3.
 LA-1549: R scapula, 2008; 3 MR cora-
 coids, 291, 1059, 513N531E 101.90-
 101.85; sternal end R coracoid, 1259;
 DR ulna, 525N565E 101.40-101.30; DR
 carpometacarpus, 1340; DR tibiotarsus
 853; ML tarsometatarsus, 291; PL tar-
 sometatarsus, 1218; DR tarsometar-
 tarsus, 1010.
 LA-25277: D symphysis of mandible,
 Loc. 2 Lot 101; PR tibiotarsus, Loc. 3.
 LA-25277: PR humerus, Loc. 1;
 L femur, Loc. 2.
 Humerus has striations parallel to
 shaft on the palmar side, possibly
 caused by cutting the wing from the
 shoulder girdle.
 Accipitriformes
 Accipitridae
Haliaeetus leucocephalus
 (Linnaeus, 1766)
Circus cyaneus
 (Linnaeus, 1766)
Accipiter cooperii
 (Bonaparte, 1828)
A. gentilis (Linnaeus, 1758)
 LA-25277: DL carpometacarpus, Loc.
 1-2; R femur, Loc. 2.
 LA-25277: PR carpometacarpus,
 Loc. 1-2.

APPENDIX: REFERRED MATERIAL (continued)

Taxon	Element ¹	Description
<i>Buteo</i> cf. <i>B. swainsoni</i> Bonaparte, 1838	LA-1549: DL ulna, 521; DL tarsometatarsus, 1232.	
	LA-25277: PR femur, DR tibiotarsus, Loc. 2.	
<i>B. jamaicensis</i> (Gmelin, 1788)	LA-1549: rostrum, 509N549E 99.80-99.70.	
<i>Buteo</i> sp.	LA-25277: R tibiotarsus, Loc. 1	All specimens from hawk similar in size to <i>B. jamaicensis</i> . D humerus (1452) is porous, probably from fledgling.
	LA-1549: R coracoid, 1336; DL radius, 286; R radius, 935; PR ulna, 521; DL humerus, 1452; PL carpometacarpus, 1283; PL femur, 1500; DL femur, 513N533E (surf.); PR femur, 1325; L tibiotarsus 513N533E (surf.); PL tibiotarsus, 39; 3 DL tarsometatarsi, 272, 641, 1259.	
	LA-25277: PR ulna, ML humerus, Loc. 1; DL ulna, PR humerus, DR femur, MR tibiotarsus, Loc. 1-2; 2 PR ulnae, 2 PR femora, Loc. 2; PL tarso-metatarsus, Loc. 3.	
<i>Aquila chrysaetos</i> (Linnaeus, 1758)	LA-1549: PR scapula, 997; DL ulnae, 394, 805.	
	LA-25277: PL carpometacarpus, Loc. 2.	
Falconidae		
<i>Falco sparverius</i> Linnaeus, 1758	LA-1549: PL ulna, 855; DR tarsometatarsus, 270.	

- F. columbarius*
Linnaeus, 1758
cf. *F. peregrinus*
Tunstall, 1771
cf. *F. mexicanus*
Schlegel, 1851
- LA: 25277: DL tarsometatarsus, Loc. 2. Burned.
- LA-25277: DL humerus, Loc. 1; DR ulna, Loc. 1-2; R femur, Loc. 4.
LA-25277: DL humerus, Loc. 2
- Galliformes
Phasianidae
Meleagris gallopavo
Linnaeus, 1758
- LA-1549: PR carpometacarpus, 828; DL tibiotarsus, 1547.
LA-25277: PR radius, DL femur, DL tibiotarsus, Loc. 1; PR scapula, DL femur, PR femur, L tarsometatarsus missing D end, Loc. 1-2; PL femur, PR tarsometatarsus, Loc. 3.
- McKusick (1986) recognizes two breeds of domestic turkey from the prehistoric Southwest: large Indian domestic and small Indian domestic. Her criteria for distinguishing these breeds depend on comparative lengths of complete elements. No complete elements were present in this sample.
- Odontophorinae, indet.
- LA-1549: L coracoid, 1737; humeral end R coracoid, 148; R ulna, 1999; PR ulna, 1173; ML humerus, 32; DL humerus, 1422; L humerus missing D end, 291; R carpometacarpus, 94; DL femur, 1563; DR tibiotarsus, 924; L tarsometatarsus, 1906.
- L humerus (291) is incompletely ossified and from a juvenile. Specimens were compared to *Cyrtonyx montezumae*, *Oreortyx pictus*, *Colinus virginianus*, *Callipepla squamata* and *C. gambelii*, and most closely resemble *Colinus* or *Callipepla* in size and characters, but are too fragmentary for positive identification. Specimens are referred to this species based on the larger breadth of the fossa below the P head, anconal surface, in *C. squamata* com-
- Callipepla* cf. *C. squamata*
(Vigors, 1830)
- LA-1549: 2 PR humeri, 536, 826

Taxon	Element ¹	Description
Gruiformes		
Rallidae		
cf. <i>Rallus limicola</i>	LA-25277: R tarsometatarsus, Loc. 2.	pared to <i>C. gambelii</i> and <i>Colinus virginianus</i> .
Vieillot, 1819		
<i>Gallinula chloropus</i>	LA-1549: R ulna, 1571; PR ulna, 1353.	
(Linnaeus, 1758)		
<i>Fulica americana</i>		
Gmelin, 1789	<p>LA-1549: mandible, 921; 2 manubria of sternum, 928, 1357; PL scapula, 1897; PR scapula, 635; 3 L coracoids, 840, 1092, 1153; 4 humeral ends L coracoids, 143, 157, 535, 1374; 2 L coracoids missing humeral ends, 540, 1416; 3 R coracoids, 108, 288, 2003; 2 R coracoids missing humeral ends, 271, 1525; 1 P and 4 DR humeri, 1216, 513N528E (surf.), 221, 224, 1209; 3 DL humeri, 1 (surf.), 1071, 1274; R ulna, 1511; MR ulna, 1507; DR ulna, 510; 1 P and 1 DL carpometacarpus, 7, 1274; 2 R carpometacarpus, 973, 514N531E 101.45-101.35; 1 P and 1 DR carpometacarpus, 1580, 1150; L femur, 1569; 1 P and 2 DL femora, 1512, 1271, 1390; L tibiotarsus, 314; ML tibiotarsus, 1143; 4 DL tibiotarsi, 90, 520, 1038, 1446; MR tibiotarsus, 886; 6 DR tibiotarsi, 152, 358, 770, 794, 846, 984; L tarsometatarsus missing D end, 1 (surf.); 2 L tarsome-</p>	

tatarsi missing P ends, 799, 1414; 2 DL and 1 R tarsometatarsi, 78, 1025, 1575; PR tarsometatarsus, 770.

LA-25277: 4 L and 4 R femora, 1 DR femur, Loc. 1; 4 L and 1 R scapulae, 3 L and 4 R coracoids, 3 L humeri, 5 L and 4 R humeri missing P ends, 1 P, D, and MR humeri, 1 PL radius, 6 L and 3 R ulnae, 1 PL and R ulnae, 2 DR ulnae, 1 R carpometacarpus, 1 partial pelvis, 2 R tibiotarsi, 2 P and 10 DL tibiotarsi, 2 L and 1 R tibiotarsi missing P end, 3 D and 3 PR tibiotarsi, 1 L and 1 R tarsometatarsus, 2 ML tarsometatarsi, 2 R tarsometatarsi missing D ends, Loc. 1-2; 1 rostrum and lower mandible, sternum, 5 manubria of sternum, sternal half R coracoid, PR scapula, 1 DL and PR humeri, 4 L and 4 R carpometacarpi, 1 PL and 1 DR carpometacarpi, 1 partial pelvis, 1 DR femur, 1 DL and PR tibiotarsus, 1 R tibiotarsus missing P end, 1 R tarsometatarsus, 1 L tarsometatarsus missing P end, 1 DR tarsometatarsus, Loc. 2; L humerus, PL humerus, R carpometacarpus, 2 R femora, L tarsometatarsus missing P end, Loc. 3; R coracoid missing humeral end, L tarsometatarsus, Loc. 4

APPENDIX: REFERRED MATERIAL (continued)

Taxon	Element ¹	Description
Gruidae <i>Grus canadensis</i> (Linnaeus, 1758)	LA-1549: DL ulna, 1209; PR ulna, 1209; DL femur, 1287.	D femur (1287) cut from shaft by the groove and snap technique.
Ardeiformes Ardeidae <i>Botaurus lentiginosus</i> (Rackett, 1813) <i>Casmerodius ablus</i> (Linnaeus, 1758)	LA-25277: PL tibiotarsus, Loc. 1-2. LA-1549: DR femur, 1586.	
Charadriiformes Scolopacidae <i>Limnodromus</i> sp. Laridae <i>Larus</i> sp.	LA-1549: PR carpometacarpus, 350. LA-25277: L coracoid, Loc. 1-2.	

Specimen compared to *L. argentatus*, *L. glaucescens*, *L. hyperboreus*, and *L. occidentalis*, which are all larger and more robust, and *L. atricilla*, *L. canus*, and *L. philadelphia*, which are smaller. *L. californianus* has robust shaft and larger fossa below the brachial tuberosity; *L. delawarensis* has narrower furcular facet. Specimen is most similar to *L. heermanni* in size and proportions, but additional material is needed for positive identification.

Columbiformes Columbidae	<i>Zenaida macroura</i> (Linnaeus, 1758)	LA-1549: L coracoid, 532; R radius, 830; R ulna, 188; PR humerus, 1125; ML carpometacarpus, 2283; 3 R carpometacarpi, 95, 839, 1590; R femur, 1794.	Specimens compared to skeletons (n>3) of <i>A. macao</i> and <i>A. militaris</i> ; osteological characters that distinguish <i>A. macao</i> include rostrum with line of culmen broad and well rounded (narrow in <i>A. militaris</i>), and absence of angle in bicipital crest where it meets shaft of humerus (angle present in <i>A. militaris</i> ; Hargrave 1970).
Psittaciformes Psittacidae	<i>Ara macao</i> (Linnaeus, 1758)	LA-25277: PR humerus, Loc. 1; rostrum, R coracoid, L coracoid, R carpometacarpus, PR tibiotarsus, Loc. 1-2; L femur, Loc. 3	
<i>Ara</i> sp.		LA-25277: DR ulna, Loc. 1.	
Strigiformes Strigidae	<i>Otus</i> sp. (Linnaeus, 1758) <i>Bubo virginianus</i> (Gmelin, 1788)	LA-1549: DR humerus, 1615. LA-1549: L coracoid, 1883; R coracoid, 1 (surf.); ML humerus, 839; DL humerus, 1055; L tarsometatarsus, 168. LA-25277: R tarsometatarsus, Loc. 1; PR humerus, Loc. 2.	P end of L humerus (839) removed using the groove and snap technique. L tarsometatarsus (168) has 5-6 deep cuts perpendicular to P external shaft.
<i>Athene cunicularia</i> (Molina, 1782)		LA-1549: mandible, 839; L coracoid,	
			Tarsometatarsus (1551) is porous,

APPENDIX: REFERRED MATERIAL (continued)

Taxon	Element ¹	Description
<i>Asio flammeus</i> (Pontoppidan, 1763) <i>Asio</i> sp.	1165; 2 R coracoids, 858, 1993; L humerus, 971; DR tibiotarsus, 905; R tarsometatarsus, 1551; 2 DR tarsometatarsi, 905, 1507. LA-1549: rostrum, 1915. LA-1549: fragmentary mandible.	probably from a fledgling.
Piciformes Picidae <i>Colaptes auratus</i> (Linnaeus, 1758)	LA-1549: PR humerus, 855; L and R carpometacarpus, 1349, 1220; PR tibiotarsus, 801.	
Passeriformes Tyrannidae <i>Tyrannus</i> sp.	LA-1549: partial mandible lacking P ends, 1994.	
Corvidae cf. <i>Cyanocitta stelleri</i> (Gmelin, 1788) <i>Corvus cryptoleucus</i> Couch, 1854	LA-25277: DL tibiotarsus, Loc. 2. LA-1549: sternal ends L and R coracoid, 751, 266; PR humerus, 1390; R femur missing P end, 405; 1 DL and R tibiotarsi, 1452, 851.	L humerus from LA-25277 (Loc. 1-2) is porous, probably from a fledgling.

- Corvus* sp.
 LA-25277: L coracoid missing humeral end, L humerus missing P end, Loc. 1-2; D and PR ulnae, Loc. 2.
 LA-25277: ML tibiotarsus, DR tibiotarsus, Loc. 2. Both burned.
- Emberizidae
Cardinalis cardinalis (Linnaeus, 1758)
Chondestes grammacus (Say, 1823)
Zonotrichia sp.
 Emberizinae, indet.
Agelaius phoeniceus (Linnaeus, 1766)
Sturnella sp.
 LA-1549: partial mandible, 2172.
 LA-1549: partial rostrum, 1325.
 LA-1549: 2 mandibles, 60, 971.
 LA-1549: rostrum, 851.
 LA-1549: rostrum, 639; mandible, 639.
 LA-1549: rostrum, 1078; L and R mandibles, 1330, 1207; D portion of mandible, 2256.
- Euphagus cyanocephalus* (Wagler, 1829)
 Icterinae, indet.
 LA-1549: rostrum, 1166.
 LA-25277: L humerus, Loc. 1.2.
- Passeriformes
 Fam. et Gen. indet.
 LA-1549: sternum, 639; 2 manubria of sternum, 1472, 1942; 7 L coracoids, 639, 1247, 1341, 1356, 1858, 1983, 2144; 5 R coracoids, 21, 258, 639, 969, 1190; DL scapula, 1 (surf.); 6 L humeri, 283, 639, 720, 1235, 1613, 1970; 3 R humeri, 639, 1010, 1237; 2 PL humeri, 1726, 2282; 3 PR humeri, 382, 1467, 1472; R humerus missing
 L humerus (1613) and PR ulna (855) from LA-1549 burned. Shaft of DR tarsometatarsus (1425), also from LA-1549, cut.

tarsi, 639, 2075, 2158; 5 R tarsometatarsi, 1981, 2140, 1194, 1966, 2253; 3 PL tarsometatarsi, 2129, 2144, 2146; 3 PR tarsometatarsi, 639, 1385, 2037, DL tarsometatarsus, 1969; 4 DR tarsometatarsi, 102, 639, 1168, 1425.
LA-25277: R coracoid, L and R ulna, P and DR ulna, Loc. 2.

¹D = distal; P = proximal; M = medial; R = right; L = left